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ABSTRACT

The purpose of this paper is to inform novice science teachers and science teacher educators of the pedagogy that science teacher supervisors value. As expert practitioners, supervisors have a perspective quite different from that of both novice teachers and teacher educators. Nine inservice science teacher supervisors assessed a novice teacher's videotaped lesson on mitosis. Their teaching experience ranged from 5 to 30 years and their supervisory experience ranged from 4 to 16 years. Five supervisors were certified as school administrators while seven had taught high school biology. The supervisors were individually interviewed within one day of viewing the videotape. The supervisors addressed 19 different aspects of the lesson. All valued indirect, activity-centered instructional methods over direct, teacher-centered approaches; small groups as an efficient arrangement for managing activity-centered instruction; classroom routines as an efficient way to effect regular procedures and hold students accountable for meeting expectations; and teachers who could engender cooperation in their students. The supervisors still expected teachers to transmit, albeit indirectly, the body of knowledge specified by an external curricular authority and to evaluate students' attempts to copy that knowledge correctly. Implications for teacher educators are discussed. Contains 25 references. (PVD)

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Inservice Science Supervisors' Assessments of a Novice Science Teacher's Videotaped Lesson

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Inservice Science Supervisors' Assessments of a Novice Science Teacher's Videotaped Lesson

Inservice science supervisors are the ultimate science-teacher developers. They are the veteran science teachers who have at least some responsibility, either as coaches or formal evaluators, for assessing the novice science teachers in their department, school, or district. Moreover, as expert practitioners, their pedagogical values shape the institutional culture and practices of all their science-teaching colleagues (Bullough, 1989; Taylor, 1993).

The term novice refers here to inservice teachers with fewer than two years of experience. They are the probationary teachers, anxious about how they will be evaluated but often with little or no idea of what their supervisors expect (Brickhouse & Bodner, 1992; Fuller, 1969). What competencies do inservice science supervisors expect in a novice science teacher? What kind of pedagogy do they value? How are those values expressed in their assessment of a particular lesson?

This paper is a report on how nine inservice science supervisors assessed a novice teacher's videotaped lesson. The teacher is a high school biology teacher. The lesson is about mitosis, the process during regular cell division whereby duplicated chromosomes assort into two identical sets.

The purpose of this paper is to inform novice science teachers and science-teacher educators of the pedagogy supervisors value. As expert practitioners, supervisors have a perspective quite different from that of either a novice teacher or teacher educator (Borko, Bellamy, & Sanders, 1992; Brickhouse & Bodner, 1992; Bullough, 1989; Carter, Sabers, Cushing, Pennegar, & Berliner, 1987; Fuller & Brown, 1975; Reynolds, 1992; Russell, 1993). Thus this paper may give novice science teachers a better idea of what their own supervisor might value and may inform science-teacher educators of the extent the reform pedagogy is being practiced in the schools.

Specifically, the focus questions for this paper were: For a novice science teacher's videotaped lesson,

1. How did nine inservice science supervisors' overall evaluations of the lesson compare?

2. What aspects of the lesson did the supervisors address when assessing the lesson?

3. Which aspects of the lesson did at least one supervisor regard as a significant strength or weakness?

4. What comments did the supervisors make about aspects of the lesson regarded by at least one supervisor as a significant strength or weakness?

The research methods were qualitative. Open-ended interviews rather than observation checklists or

questionnaires were used so as to infer the values that drove the supervisors' assessments. Such values do in fact underlie pedagogical decisions (Ajzen, 1985; Clark & Peterson, 1986), and various researchers have recommended interview studies to infer them (Calderhead & Robson, 1991; Kagan, 1990; Munby; 1984; Pajares, 1992).

Method

The Videotaped Lesson

The lesson was taught by a teacher with 16 months of inservice experience at a New York City public high school. She was teaching New York State Regents Biology to a section of middle-class 10th graders of "average" ability. Fifteen of the 25 students were present for her 40-minute lesson on mitosis. During the lesson, a videographer moved freely about the classroom focusing at times on the whole class, a group of students, a single student, or the teacher.

The teacher began the lesson with an announcement that the next day there would be a test consisting of 25-30 multiple-choice questions. Then she asked a series of questions to focus her students on the importance of replacing the cells that we continually slough off. For example, she asked "Where does 'ring-around-the-collar' come from?" and "If we're constantly losing dead cells, how come we're not disappearing?"

Subsequently, she elicited the term mitosis and wrote on the board the aim of the lesson: "What important events occur during mitosis?"

After a few more questions to establish a definition for mitosis and emphasize the importance of chromosome replication, she explained the day's activities. As the students sat together in small groups, they would each construct their own model of the phases of mitosis. Using twisted pipe cleaners to represent chromosomes, they would tape the pipe cleaners onto a sheet of paper printed with the outline of a cell in the various mitotic phases. Then the group would collaboratively write a summary of the mitotic events. Finally a speaker from each group would read the summary to the class. Subsequently, she gave the students a sheet of paper printed with instructions on one side and the phase outlines on the other.

The teacher circulated among the four groups of students, asking questions, and monitoring and praising their work. Later she directed the groups to write their summary. By the time she called for the first speaker, however, he barely had a chance to report. Interrupted by the bell, he nevertheless continued but accelerated his delivery to a hasty finish. Immediately afterward, as students were returning the unused materials, the teacher repeated the test announcement,

adding that it would encompass the entire unit on asexual reproduction.

Data Collection

The supervisors. Nine inservice science supervisors from six New York State counties were directed to watch the videotape as if they were the teacher's supervisor assessing her lesson. Two supervisors were from districts in New York City; the other seven, from suburban and rural districts north and west of the city.

Their teaching experience ranged from 5 to 30 years with an average of 25.2 years; their supervisory experience, from 4 to 16 years with an average of 6.8 years. Eight supervisors headed their high school science department while teaching at least one science class per day, whereas one was a district-wide supervisor with no teaching duties. Five supervisors were certified as school administrators, and seven had taught high school biology.

The interview. The supervisors were individually interviewed within one day of having watched the videotape. A series of somewhat redundant, open-ended questions drove the interviews. The initial questions were to explore the supervisors' reactions to the lesson, especially their opinions of its strengths and weaknesses, and their suggestions for its improvement. Subsequent questions focused more directly on their own

professional experiences, including their experiences with novice teachers. These later questions provided yet another context for the supervisors to remark on the lesson and for the researcher to explore and interpret their values (Mathison, 1988).

Data Analysis

The interviews generated oral data, which were audiorecorded and transcribed. The supervisors' evaluative comments about the lesson were then identified on the transcripts, and each comment was copied and labelled with the name of the supervisor.

Next the comments were compared, and category labels were devised for the various aspects of the lesson that the supervisors addressed. Homogeneous comments, i.e., comments about a single aspect, were then sorted and labelled. Heterogeneous comments, however, were first rewritten as a set of homogeneous comments. For example, the following heterogeneous comment was rewritten as two homogeneous comments, one about managing students and the other about the use of instructional time: "Even though she went around to each group, the timing of the lesson was such that there was no real conclusion."

Next each comment was labelled as to whether the supervisor was referring to a strength or weakness in

the lesson. Performance criteria for each aspect were then compiled from the comments in that category.

The comments were subsequently sorted again, this time according to the supervisor who made each comment. Each supervisor's comments were then reviewed so as to infer his or her overall evaluation of the lesson and to identify aspects of the lesson that he or she regarded as a significant strength or weakness. An aspect was so identified if the supervisor indicated that it had a crucial impact on the effectiveness of the lesson. Finally, the various supervisors' comments about each aspect identified as a significant strength or weakness were summarized.

Results

Overall Evaluations

The nine inservice science supervisors' overall evaluations of the videotaped lesson ranged from satisfactory to excellent. One evaluated the lesson as satisfactory; six, as good; and two, as excellent.

Aspects of the Lesson

During the interviews, the supervisors addressed a total of 19 different aspects of the lesson. These 19 aspects are listed alphabetically in Table 1, along with their performance criteria and the number of supervisors addressing each one. In fact, the supervisors tended to address many of the same aspects. For example, more

than half the supervisors commented on the following nine aspects of the lesson: classroom routines, congruence between the activities and objectives, giving directions, lesson structure, managing students, questioning techniques (use of questions), student engagement, teacher's personality, and the use of instructional time.

Aspects Identified as a Significant Strength or Weakness

A total of 10 of the 19 aspects were regarded by at least one supervisor as a significant strength or weakness of the lesson (see Table 2). Moreover, here too, the various supervisors tended to agree. That is, most of them regarded the lesson structure and the teacher's personality as significant strengths and her use of instructional time as a significant weakness.

The following are the summaries of supervisors' comments about each aspect of the lesson identified by at least one supervisor as a significant strength or weakness. The summaries are presented in the order that the aspects are listed in Table 2.

Lesson structure. The supervisors appreciated the "hands-on" structure of the lesson and the teacher's use of small groups, especially in the high-risk situation of being videotaped. Moreover, they saw the lesson as an opportunity for the students to become involved in a series of varied activities: constructing a physical

model, writing a summary, and reporting what they learned to the rest of the class. One supervisor, however, thought the teacher should have given her students the option of inventing their own representations of mitosis, such as with a series of diagrams drawn on cards that, when riffled, would create a cartoon-like animation of mitosis.

Teacher's personality. Although several supervisors commented that the teacher seemed wooden and criticized her expressly for not smiling, virtually all of them were nonetheless thoroughly impressed with the quality of her relationships with the students. The students respected her and cooperated with her. In addition, various supervisors remarked that she manifested "presence," "a basic gentleness and kindness," and an "innate ability to reach students."

Questioning techniques (Use of questions). Four supervisors praised the way the teacher used questions. They thought that during the initial whole-group segments of her lesson, she used questions effectively to focus her students on mitosis, connect the topic to their everyday lives, arouse their interest, and elicit essential information. Later, during the small-group segments, they thought she used questions effectively to guide her students to identify and correct their errors.

Another supervisor, however, thought the teacher should have also used questions to promote analytic thinking. For example, instead of asking "What is this phase (interphase) called?" the teacher should have asked "Why do you think this phase is called interphase?"

Managing students. The supervisors identified both strengths and weaknesses in the ways the teacher managed her students. They commended her for circulating among the groups, interacting with individual students, monitoring and praising their work, and encouraging them. Several, however, thought she should have been more aware of individuals who were "off task" and worked harder to get them involved. Similarly, some thought she should have been better at monitoring the whole class while attending to single groups or individuals.

The supervisors also made some technical comments and suggestions. For example, one praised her for ushering her students into the room and for standing in front of rather than behind the demonstration table when introducing the lesson. Another added, though, that she should have then walked around the room instead of "planting" herself in the front. Three supervisors said she should have called her students by name. One suggested that she use either an overhead projector for

her notes or write them on the board before class so as to avoid having to turn her back to the class.

Use of instructional time. The eight supervisors who addressed the teacher's use of instructional time assessed it as a weakness. She simply did not allow enough time to complete the culminating activity. Only the first of the four speakers had a chance to report, and even his presentation was interrupted by the bell. Thus two supervisors said that, even if she had to postpone the test, she should begin the next lesson with the rest of the reports so as to sustain her students' willingness to participate in small-group activities.

Most of the supervisors, however, thought her ability to anticipate the amount of time for each activity and pace the lesson accordingly would improve simply with experience. Nevertheless, they did offer some immediate suggestions for her lesson: She could appoint a student to act as timekeeper; have her students come to class with the mitotic phases already drawn; and/or use a double period for the lesson, perhaps adding an opportunity for students to identify mitotic phases on photomicrographs.

Congruence between activities and objectives. Two of the supervisors who addressed this aspect thought the lesson was an appropriate review for the test. The four others, however, thought the lesson would have been

more appropriate as a "lab" conducted shortly after the students had been introduced to mitosis. In fact, some thought that as a review, her lesson should have encompassed the entire unit on asexual reproduction and prepared her students expressly for a multiple-choice test.

Questioning techniques (Discourse management). Both supervisors who regarded her management of classroom discourse as a significant weakness criticized the teacher for overlapping her questions, using excessive verbiage, generating choral responses, and echoing her students' answers. In addition, they thought her wait time 2, the length of time she paused after a student's response (Rowe, 1986), was too short. Finally, they criticized her use of such phrases as "Tell me," recommending instead that she use the more inclusive "Tell us."

Amount of information. Both supervisors who addressed the amount of information in the lesson regarded it as a weakness. One supervisor, however, thought she should have held her students responsible for more details, such as the names of all the mitotic phases, whereas the other thought the teacher had already included too many terms and should have concentrated instead on the students' overall understanding of mitosis.

Classroom routines. The supervisors were concerned that the teacher had not yet established routines for starting the lesson and for assigning, collecting, and grading her students' written work. For example, they thought she needed a routine for taking attendance at the beginning of the period and for signaling the start of the lesson. They also thought that for such small-group activities, she should have been routinely requiring each student to write a report and that she should have been collecting and grading these reports regularly. Then her students would have known they were each accountable for their work in the group, and each would have had a summary to study for the next day's test.

The supervisors praised her, however, for efficiently dividing the class into groups and for having taught the students to work together willingly. One supervisor also commended her for having trained the students to copy notes from the board automatically.

Instructional materials. One supervisor identified two shortcomings in the instructional materials. First, the pipe cleaners could not adequately represent the chromatin in interphase. Therefore, he recommended the teacher also give the students something else for their models, perhaps some string. Secondly, because the phase outlines and the teacher's directions were printed

on different sides of the same sheet of paper, the students could not simultaneously refer to both. Therefore, he recommended the teacher print them on separate sheets.

Discussion

The Supervisors' Pedagogical Values

Despite differences in the character of their school districts and the duration of their teaching and supervisory experiences, the nine inservice science supervisors expressed remarkably similar pedagogical values when assessing the novice science teacher's videotaped lesson. For example, they all valued:

1. Indirect, activity-centered instructional methods over direct, teacher-centered approaches;
2. Small groups as an efficient arrangement for managing activity-centered instruction;
3. Classroom routines as an efficient way to effect regular procedures and hold students accountable for meeting expectations; and
4. Teachers who can engender their students' cooperation.

Indeed, there were only two aspects about which the supervisors explicitly differed: the congruence between the activities and objectives and the amount of information in the lesson. In each case, the difference may have issued from contrasting views of a teacher's

responsibilities. The supervisors who criticized the activity-centered review of mitosis as an inappropriate or inadequate preparation for the test seemed to hold teachers ultimately responsible for what their students learned, whereas those satisfied with the review seemed to entrust that responsibility to the students themselves. Similarly, the supervisor who found insufficient detail in the lesson believed teachers had a primary responsibility to "share the information of their discipline," whereas the one who thought the amount of information was excessive, even counterproductive, believed instead that teachers needed to "motivate and encourage their students to want to learn more."

Inasmuch as all the supervisors appreciated seeing the students actively engaged in an instructional task, their metaphor for school learning may have been one of constructing rather than absorbing a piece of curricular knowledge. They seemed, however, to expect the students to construct an exact copy of that piece of knowledge rather than a personally meaningful, albeit idiosyncratic, interpretation of it. Accordingly, they accepted the teacher's multiple-choice test as an appropriate instrument for measuring how much the students had learned.

Similarly, the supervisors valued the small groups not as an opportunity for the students to explain their own understandings of mitosis or to negotiate an intersubjective understanding of it (Solomon, 1987), but as an efficient arrangement for the teacher to monitor and assess the extent students were copying that piece of curricular knowledge correctly. Accordingly, supervisors spoke of the speakers' reports as an efficient way for the teacher to check that each group, and presumably each student, had the right answers to study for the test. Thus, to the supervisors, a curriculum was a prespecified body of public knowledge rather than the various bodies of personal knowledge students independently or consensually construct for themselves. In short, despite their preference for activity-centered instructional methods, the supervisors' views of learning, assessment, and curriculum were quite traditional (Taylor, 1993).

Moreover, the supervisors held the traditional workplace metaphor for the classroom. That is, they viewed the classroom as a place to work rather than as a place to learn (Marshall, 1988). They spoke of the students as if they were workers, valuing the extent they "stuck to the task" and "equally shared the burden of work in their groups." Similarly, the supervisors spoke of the teacher as if she were a production

manager, valuing the extent she established routines so as to keep the students accountable, completed the activities so as to sustain their willingness to participate, and monitored and praised their work so as to maintain control of the classroom.

Unfortunately, with such a metaphor, learning is associated more with prescribed routines, task completion, and product evaluation than with personal and consensual sense-making (Marshall, 1988). Thus only one supervisor mentioned allowing the students to invent their own representations of mitosis. Only one other focused on analytic thinking and the students' overall understanding of mitosis.

In summary, although the supervisors preferred activity-centered instructional methods, their pedagogy was still essentially a traditional "transmission" pedagogy. That is, they still expected teachers to transmit, albeit indirectly, the body of knowledge specified by an external curricular authority and to evaluate students' attempts to copy that knowledge correctly (Taylor, 1993).

Limitations of the Study

Several conditions may limit the validity and generalizability of the results reported here. First, the supervisors did not have a context for the lesson. That is, they did not know the prevailing culture and

customs of the novice teacher's school or classroom. Nor did they know her intentions or the background, abilities, and needs of her students. Secondly, the supervisors could only watch a videotape of the lesson, with the videographer controlling their field of vision and perturbing the instructional situation as he moved about the classroom. In short, the supervisors might have assessed the lesson differently had they known the context and actually been in the classroom.

Thirdly, the supervisors had the opportunity to assess just the one lesson. They might, in fact, have displayed a somewhat different set of values in response to another lesson, especially one taught by a teacher with other strengths, weaknesses, and values.

Finally, the nine supervisors were from New York State, where state-mandated Regents examinations have inadvertently evolved into "high-stakes" achievement tests that serve to reinforce the workplace metaphor and other traditional pedagogical values (Madaus, 1988; Taylor, 1993). Although traditional science teaching is still the dominant pedagogy (Burry-Stock, 1995), supervisors from states without such test-driven curricula might have demonstrated somewhat more progressive values.

Implications for Science-Teacher Educators and Novice Science Teachers

Science-teacher educators need to prepare novice science teachers to meet the expectations of their inservice supervisor. That is, novice teachers need to know how to devise coherent activity-centered lessons, manage small groups, establish classroom routines, and engender their students' cooperation.

Science-teacher educators also need to enable inservice science supervisors to see the reform pedagogy more comprehensively, as not just a set of novel instructional methods but a theoretically sound educational vision with profound assessment and curricular implications as well. Thus Taylor (1993) recommends that, through discourse, science-teacher educators guide entire communities of science teachers, including supervisors, to identify, reflect on, and reconstruct their consensually sustained beliefs, including the metaphors that shape their reality and constrain their practices. Taylor further recommends that science-teacher educators work with other educational stakeholders, such as administrators, parents, and students, so they can liberate their schools from external curricular authorities and empower students and teachers to negotiate their own curricula instead.

Finally, science-teacher educators need to prepare novice teachers to be agents of reform. That is, in addition to being able to model progressive teaching practices and document their benefits, novice teachers need to be able to articulate the epistemological, sociological and psychological arguments that justify reform.

Questions for Future Research

Inservice science supervisors appear to have been influenced by science education reform initiatives insofar as they have come to value activity-centered instructional methods. How are their values likely to change as reform initiatives continue? Are there, in fact, sequential stages of change for conceptions of science teaching as there seem to be for various natural phenomena (Allen-Noble, 1992; Bar, 1989; Eckstein & Shemesh, 1993; Westbrook & Marek, 1991)?

Moreover, inasmuch as the perspective of an inservice supervisor differs from that of either a novice teacher or teacher educator, how would novice science teachers assess the same videotaped lesson? How would science-teacher educators?

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Table 1

Aspects of the Lesson Supervisors Addressed

Aspect (and no. of supervisors)	Performance criteria
Amount of information (2)	The teacher expected her students to master an appropriate amount of information.
Assessment opportunities (4)	The teacher provided opportunities for herself and her students to assess their work.
Attention to learning environment (2)	The teacher controlled the physical environment to enhance opportunities for learning.
Classroom routines (7)	The teacher had routines for regular classroom procedures.
Congruence between activities and objectives (6)	The instructional activities were suited to the objectives of the lesson.

(table continues)

Table 1 (Continued)

Aspect (and no. of supervisors)	Performance criteria
Connections to other lessons (2)	The teacher explicitly connected the content to previous or forthcoming lessons.
Enforcement of school rules (2)	The teacher enforced school rules.
Giving directions (6)	The teacher made her directions, expectations, and announcements clear.
Instructional materials (1)	The teacher used materials appropriate to the objectives of the lesson.
Knowledge of subject (3)	The teacher did not make substantive scientific errors.

(table continues)

Table 1 (Continued)

Aspect (and no. of supervisors)	Performance criteria
Lesson structure (9)	The lesson consisted of a coherent series of varied learning activities.
Managing students (9)	The teacher moved about the classroom, called students by name, and monitored and praised their work so as to avert misbehavior and keep them "on task."
Motivation (4)	The teacher focused the students on the aim of the lesson and aroused their interest.
Preparation for instruction (4)	The teacher had the activities clearly in mind and the materials ready to use.

(table continues)

Table 1 (Continued)

Aspect (and no. of supervisors)	Performance criteria
Questioning techniques: Discourse management (3)	The teacher phrased her questions, paced the discourse, and responded to answers in ways that promoted thoughtful participation.
Questioning techniques: Use of questions (5)	The teacher used questions to focus her students on the topic, connect the topic to their everyday lives, arouse interest, elicit information, promote analytic thinking, and guide them to identify and correct errors.
Student engagement (6)	Most of the students were engaged in the lesson most of the time.

(table continues)

Table 1 (Continued)

Aspect (and no. of supervisors)	Performance criteria
Teacher's personality (8)	The teacher engendered cooperation and established respectful relationships with her students.
Use of instructional time (8)	The teacher alloved enough time for the various activities.

Table 2

Aspects of the Lesson Supervisors Identified as a Significant Strength or Weakness

Aspect	No. of supervisors
Strengths	
Lesson structure	8
Teacher's personality	5
Questioning techniques (Use of questions)	2
Managing students	1
Weaknesses	
Use of instructional time	7
Congruence between activities and objectives	3
Questioning techniques: (Discourse management)	2
Amount of information	1
Classroom routines	1
Instructional materials	1